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-USSR-

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In the years of the Soviet regime an advanced metallurgical industry was built in our country. The production of ferrous metals in the USSR increased 13 times as compared to the level of 1913. Today the annual increase in the production of iron and steel is greater than the annual production of czarist Russia. In 1959, 43 million tons of iron and almost 60 million tons of steel were produced, that is, our output was greater than in any country in the world with the exception of the US. Today the USSR produces appreciably more steel than Britain, France, and West Germany put together.

In spite of this gigantic growth of the metal production in the country, the ever-increasing requirements of heavy industry, transportation and communications, electrification and gasification of the country, mechanization of agriculture, housing, and the growing demand of the workers for consumer's goods, call for continually increasing quantities of metal from year to year. Therefore, the Seven-Year Plan for the Development of National Economy provides for an increase of production of iron to 65-70 million tons, steel to 86-91 million tons, and rolled stock to 65-70 million tons by 1965.

The increase in metal production is the principal means of satisfying the requirements of the national economy, but not the only one. Moreover, the development of the production equipment of metallurgy is extremely complicated and expensive. The mining of ore and coal with the subsequent production of coke, smelting of iron and steel, and the production of finished product, namely, rolled iron and steel, require enormous inputs of labor, great capital investments, and large amounts of equipment, metal, pipe, and other materials. For example, an investment of approximately four billion rubles and 400,000 tons of rolled iron and steel is required for building a complete plant with an annual output of one million tons of rolled iron and steel.

The second means of increasing the metal resources in the country, which consists of its economical use in all stages of consumption, a thrifty, proprietary attitude toward each ton of rolled metal, and also the collection of iron scrap, does not require great expenses. Therefore, the Party and the government have always directed the special attention of economic organs toward a thrifty utilization of metal in all branches in industry and in capital construction.

The appeal of the Central Committee of the CPSU for economical consumption of ferrous metals in the national economy states: "The efficient utilization of ferrous metals, the struggle for their economical use must become an all-national duty and be carried out everywhere, in all establishments, constructions, transportation, agriculture, scientific-research and long-range planning and design organizations, and in cities and settlements."

Which, then, are the trends of efficient utilization of metal and in which stages of its consumption do the greatest sources of economy exist?

One of the principal metal consumers is machine building and the greatest source of economy of metal is decreasing the weight of machines. The possibilities of economy in metal can be practically realized primarily in the process of designing and planning new machines, assemblies, equipment, means of transportation and construction. According to the scheduled figures for the development of national economy in the years 1959-1965 in the machine-building industry a decrease of not less than 25% on the average is planned for the specific quotas of consumption of rolled metal for the seven-year period or, on the average, of 3.6% annually. Consequently, the machine-building industry of the country must in the future economize not less than one million tons of rolled iron and steel annually. This means that the engineering-technical workers of plants,

design offices, and scientific-research institutes of all metal-consuming branches of industry and, primarily, of the machine-building industry, must produce more powerful motors of smaller size, lighter and more productive operating machines and assemblies. Another important source of economy of metal is the modernization of the machines and equipment manufactured, replacement of metal in machine and assembly parts with plastics, reinforced concrete, and other materials. In many branches of industry and in capital construction substitution of reinforced concrete and other non-metallic materials for metals is the principal means of saving of steel and rolled stock.

In view of the gigantic proportions of industry and capital construction being achieved under the Seven-Year Plan, the selection of one or the other type of the machine or construction design and the organization of the technological process have an enormous significance in the economy of metal consumption.

During recent years we have designed many highly productive machines and equipment which afforded savings of millions of tons of metal. For example, in transportation machine building, owing to the production of large-load 60--90-ton railroad freight cars, dump cars, and semi-cars instead of 20-ton cars, and of new, powerful diesel and electric locomotives instead of steam locomotives, the expenditure of metal is decreased by 30-40% per ton of carrying capacity and approximately 800,000 tons of metal were saved during the past 15 years.

In boiler and turbine construction the building of powerful turbines of 50,000-100,000 kw and higher capacity instead of the formerly produced turbines of 1,000-5,000 kw, as well as the production of boilers with increased steam parameters afforded a reduction in the relative consumption

of metal by 2/3 or 3/4 per kilowatt capacity and ton of steam, which resulted in savings of hundreds of thousands of tons of metal for the country.

The ChTZ (Chelyabinskii Tractor Plant -- Chelyabinskii Traktorny Zavod) in the construction of the S-80 tractor used 9.57 kg of rolled iron and steel per horse power. Today ChTZ produces more powerful S-100 and S-140 tractors. Their design affords a reduction of 7.3 kg and 6.9 kg respectively, in the amount of rolled stock per horse power.

In capital construction, the substitution of prefabricated reinforced concrete sections for metal structures produces an annual saving of approximately 1,500,000 tons of rolled iron and steel.

Our production of reinforced concrete increases from year to year and today it is used not only in capital construction but also takes the place of metals in some elements of bulky machines and assemblies. For example, the Kolomenskiy Heavy Machine Building Plant developed a new planing machine weighing 360 tons. The base, table, and stands of this planer are made not of metal but of concrete reinforced with thin sheet steel. This saved 210 tons of metal per planer and decreased the weight of each one by 15 tons. The Podol'skiy Machine Building Plant imeni Ordzhonikidze uses concrete for pipeless outer walls of boilers instead of metal and saves 50 tons of metal per assembly.

Reinforced concrete is extensively used in place of metal in mine bracing, power line towers, construction of bridges and aqueducts, etc.

The development of advanced designs of machines, use of lightened shapes of alloy and low-alloy rolled stock and plastics instead of the usual carbon steel, as well as extensive utilization of reinforced concrete with prestressed reinforcing bars in construction are the principal means of economical consumption of metal.

It is difficult to compute the annual losses of metal caused by corrosion. Rust corrodes thousands of tons of metal and prematurely destroys buildings and structures. The fight against corrosion is a major problem of the national economy. The leading role in solving this problem belongs to the chemists. The chemical industry must supply the machine builders with durable corrosion-resistant coatings: varnishes, paints, enamels, plastics, etc. Metallurgists must organize the production of double-layer metals, in particular of pipes with protective coatings of plastic, glass, enamel, etc. The temporary coating of metal with protective greasing or special film prior to shipping must be more extensively practiced. Chemists must appreciably improve the quality of coatings, especially of varnishes and paints. Good anti-corrosion coatings prolong the life of machines, structures, and buildings and contribute to the economy of metal.

An important reserve in the economy of metal lies in improving machining technology and in increasing the efficiency of its performance. We must say that although the machine builders have achieved certain successes in the reduction of the relative consumption of metal, its utilization is not as efficiently handled. Great amounts of rolled stock can be saved by increasing efficiency in its machining. Thus, the wastes resulting from machining metal at machine-building plants fluctuate

between 15% and 50% for rolled stock on the whole and between 35% and 60% for profile steel and sheet metal.

Even the leading plants provided with modern equipment exhibit low efficiency in the utilization of rolled stock. Frequently plants that are similarly equipped exhibit different efficiencies in the utilization of rolled iron and steel in machining. For example, at the Gor'kiy Motor Vehicle Plant the efficiency of utilization of rolled stock for trucks is 76-77%, whereas at the Moscow Motor Vehicle Plant imeni Likhacheva the efficiency is 72-74%. It must be borne in mind that a saving of one per cent at these two plants constitutes 10,000 tons of metal annually.

During recent years the efficiency of utilization of metal in machine building and machining has increased. Machining waste in 1957 was 1.3% lower than in 1955 and constituted 21% of the metal consumption accounted for. Nevertheless, the amount of waste of ferrous metals incurred in machining is still high. Especially great amounts of metals are wasted as chips. The high percentage of metal wasted in the form of chips, as well as trimmings and scissel can only be ascribed to poor management. The principal cause of high wastage is the inefficient laying out of patterns for stamping and cutting sheet metal, beams, girders, and profile steel, non-uniform metal stock supplied to the machine-building industry by the metallurgical industry, and poor utilization of wastes.

In order to economize sheet metal it is necessary to use more extensively the methods of efficiently laying out patterns on the sheets, including the mathematical method of finding the optimum lay out of the pattern on the sheet. To decrease losses of metal in the form of chips, metal-working plants must be supplied with rolled stock of appropriate shapes and should use upsetting, pressing, precision casting, etc., more extensively instead of cutting. Machining waste, such as scissel and trimmings left over from sheet and structural steel, should be used at the plants for production of small items. All this will afford a reduction of metal losses from waste.

Many establishments work every day on the problems of reducing waste and on the efficient utilization of waste products. Thus, at the "Krasnoye Sormovo" plant, in laying out the pattern for stamping sheet metal the MDFK [?] locking device is used. This procedure reduces waste in stamping sheet steel by 15%. This apparatus is easy to manufacture and operate. However, it is not extensively used. If all machine builders would achieve such economy as the Sormovo men, the total savings in the entire national economy would amount to more than a million tons of metal.

Unfortunately many machine-building plants do not devote proper attention to the problem of the economical utilization of metal. Losses incurred in machining rolled stock are especially high. Here losses and over-expenditure of metal are accompanied by excessive losses of labor, fuel, and power, thus increasing the cost of the products manufactured.

The causes of high losses of rolled iron and steel in our machine building can be reduced to three groups.

The first and principal group is connected with organizational and technical kinks in the metal working industry and distribution system. This includes unwarranted substitutions of heavier sections for the required rolled stock; disruptions of the technology in the machining process, and rejects. The weak organization of standardization of metal consumption and control causes high excessive consumption of metal.

The second cause is the insufficient introduction of economical progressive types of rolled stock, namely, of profile iron (*piriodicheskiy profil*), calibrated and cold-rolled steel, and low-alloy steel.

Lastly, the third cause is the insufficiently extensive use of cold pressing, die stamping, upsetting, burrfree stamping, and other progressive methods of pressworking.

Wherever the Councils of National Economy and industrial establishments are striving for economical metal consumption definite successes are attained in the adoption of progressive measures which contribute to saving of metal. For example, at the Gor'kiy Motor Vehicle Plant organizational-technical methods have been developed for the adoption of lightened rolled profile stock and cold-pressed stock and also for the more efficient utilization of rolled stock. As a result, in 1958 the consumption of rolled stock per GAZ-51 vehicle was reduced by 6.1%. In 1959, 16,000 tons of rolled stock was saved. For the current year measures were developed which will save 5% of the metal. At the Uralvagonzavod (Ural Railroad Car Plant) the substitution of low-alloy steel for merchant steel and the extensive utilization of economical and bent shapes of rolled stock reduce consumption of metal and lighten the weight of the cars built. This measure alone saved over 4,000 tons of rolled stock in 1959.

Many Sovnarkhozes (Councils of National Economy), including the Bryanskii, Novosibirskii, Permskiy, and Moscow Oblast Sovnarkhozes have not yet taken the necessary measures for economy of rolled stock and pipe in machine building. Consumption quotas are approved only for a limited number of items and this opens the doors to wastefulness. The organization-technical measures for economy of metal are inadequate in many industrial establishments; moreover, they are not always practiced. This results in large excessive consumption of rolled stock.

Although the Altayskiy and Stalingrad Tractor Plants have similar technical equipment, their rolled stock quotas for the DT-54 tractor are different. The Altayskiy plant uses much more rolled stock per tractor than the Stalingrad plant. If the Altayskiy plant would lower the amount of metal used in one DT-54 tractor to the level of the Stalingrad plant quota it would save annually enough rolled stock to manufacture an additional 1,000 tractors. However, even the achievement of the Stalingrad plant personnel is not the limit. In comparison with the Khar'kov Tractor Plant, the Stalingrad tractor builders during the years 1958-1959 permitted a 700-ton excess in the consumption of rolled stock, of which an additional 300 tractors could have been built at this plant. Especially great losses are caused by replacing the shape of rolled stock ordered by a heavier, thicker, or larger-diameter type. Thus, in 1958

the Altayskiy Tractor Plant used up an excess of 5,011 tons of rolled stock. This was caused by the mass replacement of the lightened sections of rolled stock with heavier stock, as the result of which the plant lost 2,749 tons through rejects and 2,262 tons through disruption of the technological process.

The Novosibirskiy Sovnarkhoz, for the third year in succession, permits an excessive consumption of rolled stock in agricultural-machine building through the mass substitution of one shape of rolled stock for another. From the metal wasted in 1959 an additional 4,000 sowing machines could have been built.

In 1958, the Kalininskiy Railroad Car Plant, not having received on time the necessary sectional stock from the metallurgical plants, used an excess of 182 tons of structural and commercial sheet steel and 28 tons of profile steel.

The adduced facts show that the excess consumption of metal by the Altayskiy, Novosibirskiy, and Kalininskiy Sovnarkhozes occurs mainly through organizational-technical troubles. Frequent unwarranted replacements of one shape and dimension of rolled stock with another one, disruption of the technology, rejects, and disregard for the advanced methods of metal-working, namely, die stamping, pull broaching, and burrfree stamping, result in high losses of rolled stock in the production process and excessively heavy machines and equipment. The above facts are characteristic to a certain degree of machine-building plants of certain other Sovnarkhozes also.

The responsibility for the excess consumption of rolled iron and steel lies with the metallurgical plants. As indicated by the data of the surveys performed in 1958 and 1959, many metallurgical plants do not fill the orders of the machine builders on time and they deliver the wrong kind of assorted rolled stock, arbitrarily replacing light-weight shapes with heavy ones, deliver commercial steel instead of low-alloy steel thereby causing excess consumption of metal, and even deliver rejects. For example, the Technical Control Department of the Kalininskiy Railroad Car Building Plant rejected more than 200 tons of rolled stock received from the Chelyabinskii, Nizhne-Tagil'skiy, Makeyevskiy, and Dneprodzerzhinskii plants.

The Magnitogorskii Metallurgical Kombinat (Combine) delivered to the Mytishchinskiy Plant No 12 girders 8- and 9-meters long instead of the required cut length girders of 8.34-m long, and No 8 girders instead of No 6, causing high waste of rolled stock.

The use of low-alloy steel instead of merchant steel yields a 15-30% economy of rolled stock in machine building and construction. Due to the existence of rich nickel-bearing iron ores in the Yelizavetinskii and Khalilovskii deposits and also to the large amounts of nickel-containing machining wastes, our metallurgy can fully satisfy the requirements of machine building industry in low-alloy steel.

The rolling mills of our metallurgical plants today produce a limited assortment of rolled stock, consisting mainly of heavy and uneconomical shapes. This impedes the designers' efforts toward decreasing the weight of machines and structures, causes waste of metal, increases

labor necessary for production at machine building plants, causes inefficient loading of metal-cutting machine shops, and results in large losses of metal in the form of chips and trimmings.

The metallurgists must improve the quality and assortment of rolled stock. Experience shows that losses of metal can be decreased in the process of its production during all of its reduction operations by decreasing the amount of rejects, and losses in burning and trimming. An appreciable economy in metal will be achieved through the extensive production and use in all the branches of the national economy of semi-killed steel instead of rimmed steel, of standardized and heat-treated metal, and economical and bent shapes of sections and pipe.. More sectional profile rolled stock and high-strength drawn wire for reinforcing concrete must be produced.

An extremely important task for metallurgical establishments is the all-round increase of the production of structural pipe, especially of welded pipe made of steel with high mechanical properties. A great economical effect will be achieved by the extensive use on a national scale of heat treatment of sheet and shaped rolled stock. At the end of the Seven-Year Plan one per cent of savings of rolled stock will equal 700,000 tons per year. Heat treatment of rolled stock saves 17-33% of the metal. Thus the amounts of savings of metal on the national scale will depend on the amount of heat-treated metal.

Abroad the production and use of bent sectional rolled stock is very extensive. Opportunities for its utilization in our country are very great. The Zaporozh'ye Metallurgical Plant has developed the production of bent sectional rolled stock but its assortment is still limited and its production inadequate. The construction of the shop and the mastering of the process of production of bent sectional rolled stock proceeds slowly. Thus, according to the plan for 1959 the plant was obligated to supply various plants of the RSFSR with 30,000 tons of bent sectional rolled stock but delivered only 900 tons. In its place the plant delivered sheet metal rolled stock. It is necessary to increase the production of bent sectional rolled stock in the nearest future.

The use of standardized steel instead of hot-rolled stock in machine building produces a 35-40% economy in machining of rolled stock. However, the production of standardized steel in the country is inadequate and as a result, in the RSFSR alone over 100,000 tons of hot-rolled stock is consumed annually. The annual losses of metal from machining, i.e., in the form of chips, add up to 35,000-40,000 tons. The same situation exists in the other republics. Metallurgists and machine builders do not pay sufficient attention to the standardization of rolled stock and continue to use hot-rolled stock, transforming an appreciable portion of it into chips.

The low efficiency in the use of rolled iron and steel in machine building is ascribed also to insufficient adoption of hot and cold stamping, cold upsetting, and die stamping of metal. One of the principal causes of this is the inadequate number of presses and the unsatisfactory utilization of the existing advanced press-forging equipment. The fault lies with the machine builders themselves.

The machine-building plants of the country annually consume thousands of tons of merchant shapes for the production of bolts, nuts, cotter pins, and rivets, convert into chips 40-50% of the metal machined, and thereby increase the cost of bolts and nuts five times. At the same time the automatic bolt and rivet machines at the specialized hardware factories of the RSFSR during the past few years have been working only to 70-75% of capacity. This is caused by the fact that the planning offices underestimate the norms of production of bolt and rivet items at specialized plants, allegedly because of the absence of metal; at the same time they permit its extreme over-consumption at nonspecialized machine-building plants for the same purposes. It is imperative that the centralized production of metal fasteners be increased.

The gigantic scope of capital construction during the seven-year period will require more than 50 million tons of metal and over 15 million tons of steel and cast iron pipe. Hence, the problem of the thrifty use of metal in capital construction has an enormous significance in the national economy. Each per cent of metal saved here will yield over 50,000 tons of rolled stock during the seven-year period. The opportunities presented by construction for economizing metal are indeed gigantic.

The use of prefabricated reinforced concrete, especially with prestressed reinforcing instead of metal structures and monolithic reinforced concrete; the introduction into the construction of buildings and structures of low-alloy profile and lightened rolled stock and bent sectional steel, steel wire, and welded sheet metal constructions, where because of technical causes it is impossible or unprofitable to use prefabricated reinforced concrete, and the use of nonmetallic building materials -- these are some of the reserves of economy of metal in building.

In the past five years the production of reinforced concrete in the USSR increased to 29 million cubic meters. This saves over 1,500,000 tons of rolled stock annually on the national scale. In spite of the enormous work performed during the recent years for the reduction of metal used in capital construction its consumption here is still high and constitutes 42-45 tons per one-million-rubles' worth of building and installation work.

What, then, are the causes of excessive consumption of rolled metal in capital construction? The share of metal structures in the over-all consumption of rolled metal by capital construction is still large; it is approximately 20%. The greatest source of economy of metal lies in replacing it with reinforced concrete. A great amount of rolled metal is saved through the use of wire in the production of reinforced concrete. One ton of steel wire in reinforced concrete replaces 2.8 tons of rolled stock, and a ton of ordinary wire replaces 1.4 tons of rolled stock. Unfortunately, the share of wire in the over-all consumption of rolled stock in capital structure is insignificant and amounts to only 0.5-0.6% for steel wire and 4-5% for ordinary wire. The builders must use prestressed steel wire only. This will yield the best results.

The use of periodical and low-alloy rolled stock in construction saves 20-25% of metal. However, the metallurgists do not meet the

increased demand of the consumers. To satisfy one half of the requirements of the builders they supply ordinary smooth rolled stock and this fact results in hundreds of thousands of tons of excessive annual rolled-stock consumption on the national scale.

In recent years slate, asbestos-cement plate, and tile became extensively used in the USSR as roofing materials. Such roofs last longer than metal roofs and their maintenance is easier than that of the metal roofs. Nevertheless, at least 250 tons of sheet steel and iron are used for roofing.

In the timber-rich northern and eastern regions of the country prefabricated reinforced concrete must be more readily replaced with lumber, quarrystone, and other native building materials in the housing industry. This will save not only metal but cement also.

Much rolled stock is still used for the production of consumers goods which can be successfully manufactured of wood and other plentiful materials. Thus, for example, the production of metal beds consumes annually on the national scale more than 500,000 tons of rolled stock and over 150,000 tons of thin-walled welded pipe. From 32-42 kg of hard-to-get pipe and rolled stock are used for each bed. Is this not wasteful in our lumber rich country! It is time that we halt production of metal beds, increase by every available means the production of wooden beds, and use the hundreds of thousands of tons of rolled stock thereby saved for more pressing needs.

Today in our country there are over four million tons of carry-overs of rolled iron and steel, of which only about 600,000 tons are in the supply stores. The balance of the mass of rolled stock is dispersed among the consumers. As a rule, the assortment of rolled stock is incomplete: a plant may have a sufficient amount of one size of shapes for half a year, whereas there is not enough of other sizes for current production. All this enormous mass of rolled stock is neither controlled nor regulated by distribution organizations. If one consumer has an excess of a certain size of shaped rolled stock which is desperately needed by another consumer for current production, the marketers have no right to reassign it. The marketing agencies are not responsible for the timely fulfillment of orders or for breaking delivery agreements, and they do not inspect the quality of the products delivered.

The existing specialization of rolling mills does not satisfy the requirements of the consumers under the present system of plans concerning moving stocks and marketing of metal. The quota of storage time for the moving stocks of rolled metal in machine building and metal machining is set by Gosplan SSR (State Planning Commission USSR) at 28 days. Metal is rolled by the metallurgical plants at the following times: shaped and sheet rolled stock, once a month; beams and girders, once per quarter; individual grades of rolled stock, 2-3 times per year. The existing installation quotas for rolled stock are 200-300 tons. If the consumer requires 100 tons of rolled stock of a certain size and shape for one month, 100 tons of another size for the second month, and 100 tons of still different size for the third month he is forced to order 300 tons

of the rolled stock of the largest size at once for the three months. If the consumer requires only 30-40 tons of rolled stock, the metallurgical plant cannot ship this quantity, since the railroad transit quota is 62 tons.

In order to avoid excessive consumption of rolled stock in machine building resulting from improper substitution of one shape and size of stock for another, the Councils of National Economy must establish wholesale and retail distribution bases of metal supply and increase the amount of metal available there 3-4 times to enable the consumer to obtain the required shape and size of rolled stock at any time.

Thus, for example, the Moscow office of Rosglavchermetsnabsbyt (Main Administration of Ferrous Metal Supply and Marketing RSFSR) today has a yearly turnover of more than one million tons. To fill the minor orders of consumers it ships rolled iron and steel to its supply bases in large-load cars. The rolled stock is thereupon sorted according to the types ordered and shipped to Moscow consumers in the office's own trucks and to the Kalininskiy, Tul'skiy and Kaluzhskiy Sovnarkhozes in large-load cars. This office is capable of assuming the entire responsibility for supplying consumers and for liquidating the supply bases located in the Moscow City and Moscow Oblast Sovnarkhozes if it were subordinated to one of them.

As indicated by the experiences of the Moscow office of Rosglavchermetsnabsbyt, the existence of such wholesale supply bases would make it feasible to assemble assorted metal, load into a single 62-ton car five or six sizes of rolled stock, and avoid the substitution of one size for another in the process of consumption. An order must be established according to which the supplier shall be fully responsible for all losses incurred by the consumer as a result of delayed delivery or delivery of the wrong type of metal. The contract must have effective power!

An exceptionally important reserve for increasing steel production is the increase of scrap resources. The volume of steel production is in direct relationship with the quantity of iron scrap collected. An over-fulfillment of the plan of metal scrap collection in the current year by only one per cent will permit the metallurgists to produce an additional 200,000 tons of steel. In order to produce this amount of steel by the ordinary method it would be necessary to produce an additional amount of more than 200,000 tons of pig iron, for the smelting of which 500,000 tons of iron ore and 250,000 tons of coking coal would be required.

The operation of collecting, sorting, and processing all types of ferrous scrap and its storage must be improved since a large quantity of scrap loses its value and is irretrievably lost through improper storage. Throughout the nation there are hundreds of thousands of tons of worn-out and useless machines and equipment. Their timely delivery as scrap will afford an appreciable increase in steel production.